PATENT ABSTRACTS OF JAPAN

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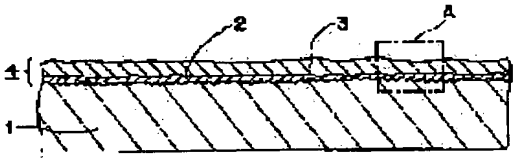
(54) COMPOSITE FILM OF METALLIC SURFACE AND ITS FORMATION



(57)Abstract:
PURPOSE: To improve or reform the properties based only on the ceramic thermally sprayed film by adopting titanium nitride as the essential component of the primary-thermally sprayed film of the composite film consisting of the primary-thermally sprayed film and the ceramic thermally sprayed film thereon.
CONSTITUTION: The primary-thermally sprayed film 2 is formed on the surface of, for example, an Al substrate 1 by plasma thermal spraying of pure Ti powder in the atm. after a blasting treatment. Next, the ceramic thermally sprayed film 3 consisting of white alumina is formed by plasma thermal spraying of white alumina powder on the film 2, by which the composite film 4 is formed. The pure Ti reacts in the atm. and most thereof turns to the titanium nitride and, therefore, the film 2 mostly consists of the titanium nitride. The coeffts. of thermal expansion the titanium nitride and the Ti exist between the coeffts. of thermal expansion of the Ti and the alumina and, therefore, the adhesion property of the film 3 to the substrate 1 is improved by bonding this film via the film 2 to the substrate. Since the Ti reacts with Al, the adhesion property of the film 2 to the substrate 1 is improved. The insulating characteristic, heat resistance and high-temp. corrosion resistance are improved.

CLAIMS

[Claim(s)]
[Claim 1] The compound coat of the surface of metal characterized by a substrate sprayed coating using titanium nitride as a principal component in the compound coat which consists of undercoat formed in the surface of metal, and a ceramic-flame-spraying coat formed on undercoat.
[Claim 2] The formation approach of the compound coat of the surface of metal characterized by carrying out thermal spraying of the titanium in atmospheric air, and forming undercoat in the approach of forming a ceramic-flame-spraying coat in a surface of metal through undercoat, and forming the compound coat which consists of both sprayed coatings.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the compound coat which consists of the undercoat and the ceramic-flame-spraying coat which were formed in the front face of metals, such as aluminum, and its formation approach.
[0002]
[Description of the Prior Art] In forming a ceramic-flame-spraying coat in a surface of metal, in order to ease the difference of the coefficient of thermal expansion of a metal and a ceramic and to raise both adhesion, generally forming among both the undercoat which consists of an ingredient which has both middle coefficient of thermal expansion is performed. And undercoat was what consists of a metal conventionally.
[0003] By the way, the purpose which forms a ceramic-flame-spraying coat in a surface of metal has insulating improvement, heat-resistant improvement, etc. variously. For example, in aiming at insulating improvement, it forms the thickness which presents desired insulation, and the ceramic-flame-spraying coat of an ingredient. However, since there was an upper limit in the thickness of the ceramic-flame-spraying coat which can be formed, there was a limitation also in insulating improvement. Such a limitation was the same also in the manifestation of other properties not only based on insulation but a ceramic-flame-spraying coat.
[0004]
[Objects of the Invention] this invention person considered making the property of undercoat act on the property based on a ceramic-flame-spraying coat additively or in multiplication by changing this paying attention to the quality of the material of undercoat. Namely, this invention aims at offering the approach of forming such a compound coat for the purpose of offering the compound coat of the surface of metal which can improve or reform the property only based on a ceramic-flame-spraying coat.
[0005]
[Means for Achieving the Goal] The compound coat of the surface of metal of this invention is characterized by a substrate sprayed coating using titanium nitride as a principal component in the compound coat which consists of undercoat formed in the surface of metal, and a ceramic-flame-spraying coat formed on undercoat.
[0006] The formation approach of the compound coat of the surface of metal of this invention is characterized by carrying out thermal spraying of the titanium in atmospheric air, and forming undercoat in the approach of forming a ceramic-flame-

spraying coat in a surface of metal through undercoat, and forming the compound coat which consists of both sprayed coatings.
[0007]
[Function] In the compound coat of the surface of metal of this invention, since most substrate sprayed coatings consist of titanium nitride, undercoat will discover the property as a ceramic. Therefore, the property of a compound coat becomes that to which the property as a ceramic of undercoat acted on the property as a ceramic of a ceramic-flame-spraying coat.
[0008] Since titanium reacts in atmospheric air and tends to turn into titanium nitride, according to the formation approach of the compound coat of the surface of metal of this invention, most substrate sprayed coatings consist of titanium nitride.
[0009]
[Example] Drawing 1 is the sectional view showing the compound coat formed by the approach of this invention. As for the substrate with which 1 consists of an aluminum member, and 2, in drawing, undercoat and 3 are ceramic-flame-spraying coats. The compound coat 4 consists of both sprayed coatings 2 and 3. The White alumina was used as a ceramic of the ceramic-flame-spraying coat 3, using A5052 as an aluminum member of a substrate 1. Moreover, in the thickness of a substrate 1, the thickness of 6mm and undercoat 2 set thickness of 50-100 micrometers and the ceramic-flame-spraying coat 3 to 200-300 micrometers.
[0010] Next, the formation approach is explained. After blasting processing, grain size carried out the plasma metal spray of the pure titanium powder which is 10-44 micrometers to substrate 1 front face, and formed undercoat 2 in it. Blasting processing was performed using the alumina grid. Specifically as an alumina grid, "alundum #24" was used.
[0011] Next, the ceramic-flame-spraying coat 3 to which grain size carries out the plasma metal spray of the White alumina which is 10-45 micrometers and which it becomes from the White alumina was formed on undercoat 2.
[0012] In addition, each plasma metal spray at the time of forming undercoat 2 and the ceramic-flame-spraying coat 3 was performed on the conditions shown in Table 1 using the domestic plasma spraying equipment of output 60kw class.
[0013]
[Table 1]

	下地溶射皮膜の場合	セラミック溶射皮膜の場合
出力（電流（A）-電圧（V））	１０００Ａ－３４Ｖ	
プラズマガス（Ａｒ）量	６０ ℓ/ｍｉｎ	
ミックスガス（N_2）量	０	
パウダーガス（Ａｒ）量	５ ℓ/ｍｉｎ	
パウダー供給量	０．８ｋｇ・ｆ/ｈ	３．０ ｋｇ・ｆ/ｈ
溶射距離（ｍｍ）	１２０ｍｍ	７０ｍｍ

[0014] In this way, the ceramic-flame-spraying coat 3 was formed in substrate 1 front face which consists of an aluminum member through undercoat 2. That is, the compound coat 4 was formed. Drawing 2 is the enlargement of the A section of drawing 1 .

[0015] In the above-mentioned formation approach, pure titanium changes ****** to titanium nitride in response to the time of forming the substrate sprayed coating 2 in atmospheric air. For this reason, most consists of titanium nitride and the pure titanium of the substrate sprayed coating 2 is little. Drawing 3 is the X diffraction Fig. showing the presentation of undercoat 2. As drawing 3 shows, the content rate of titanium nitride and pure titanium is about 5:1.
[0016] The coefficient of thermal expansion of titanium nitride and pure titanium is located between aluminum and an alumina. For this reason, the adhesion over the substrate 1 of the ceramic-flame-spraying coat 3 is improving by minding undercoat 2. Adhesion reinforcement was specifically 5 kg-f/mm2. Since especially titanium reacts with aluminum, the adhesion over the substrate 1 of undercoat 2 is improving.
[0017] Since the ceramic-flame-spraying coat 3 consists of a White alumina which is a ceramic, it has insulation. Since most consists of titanium nitride which is a ceramic, the substrate sprayed coating 2 also has insulation. Therefore, the compound coat 4 will have insulation higher than the insulation only based on the ceramic-flame-spraying coat 3. That is, it means that the insulation only based on the ceramic-flame-spraying coat 3 had improved.
[0018] Below, the approach of a dielectric breakdown test and its result are shown. A result shows that insulation is improved.
a dielectric breakdown test and class: -- trial-among mind ** test-method: -- it applies to JIS-C2110 (phase breakdown test) correspondingly.
** Impression frequency : 800Hz (square wave)
** Plate-plate electrode (phi 25)
・結果

	絶縁破壊電圧気中（KV）
従来例	3．0
本実施例	7．0

In addition, the nickel-aluminum alloy was used for the conventional example as undercoat 2.
[0019] Moreover, properties, such as thermal resistance and high temperature corrosion-proof, are improvable in addition to insulation.
[0020] in addition -- even if the conditions of each plasma metal spray at the time of forming undercoat 2 and the ceramic-flame-spraying coat 3 are shown in Table 2 or 3 -- the above-mentioned example and abbreviation -- the same compound coat 4 was obtained.
[0021]
[Table 2]

	下地溶射皮膜の場合	セラミック溶射皮膜の場合
出力（電流(A)-電圧(V)）	900A－44．5V	
プラズマガス(Ar)量	60 ℓ/min	
ミックスガス(N_2)量	7 ℓ/min	0
パウダーガス(Ar)量	5 ℓ/min	
パウダー供給量	0．8kg・f/h	3．0 kg・f/h
溶射距離(mm)	120mm	70mm

[0022]
[Table 3]

	下地溶射皮膜の場合	セラミック溶射皮膜の場合
出力（電流(A)-電圧(V)）	800A−50V	
プラズマガス(Ar)量	60 ℓ/min	
ミックスガス(N_2)量	16 ℓ/min	0
パウダーガス(Ar)量	5 ℓ/min	
パウダー供給量	0.8kg・f/h	3.0 kg・f/h
溶射距離(mm)	120mm	70mm

[0023] Moreover, as a metal of a substrate 1, various ferrous materials, copper, a copper alloy, titanium, a titanium alloy, a nickel radical alloy, a cobalt base alloy, etc. may be used, and a zirconia, a titania, a spinel, yttria, etc. may be used as a ceramic of the ceramic-flame-spraying coat 3, for example.
[0024]
[Effect of the Invention] Since most substrate sprayed coatings 2 consist of titanium nitride as mentioned above according to the compound coat of the surface of metal of this invention, the property as a ceramic can be given to undercoat 2. Therefore, the property of the compound coat 4 is made to the thing which makes the property as a ceramic of undercoat 2 come to act on the property as a ceramic of the ceramic-flame-spraying coat 3, and the property only based on the ceramic-flame-spraying coat 3 can be improved or reformed. For example, insulation higher than the insulation only by the ceramic-flame-spraying coat 3 can be given to the compound coat 4, and properties, such as thermal resistance and high temperature corrosion-proof, can be further improved to it.
[0025] Moreover, according to the formation approach of the compound coat of the surface of metal of this invention, the undercoat 2 which most becomes from titanium nitride can be formed easily and certainly.

TECHNICAL FIELD

[Industrial Application] This invention relates to the compound coat which consists of the undercoat and the ceramic-flame-spraying coat which were formed in the front face of metals, such as aluminum, and its formation approach.

EFFECT OF THE INVENTION

[Effect of the Invention] Since most substrate sprayed coatings 2 consist of titanium nitride as mentioned above according to the compound coat of the surface of metal of this invention, the property as a ceramic can be given to undercoat 2. Therefore, the property of the compound coat 4 is made to the thing which makes the property as a ceramic of undercoat 2 come to act on the property as a ceramic of the ceramic-flame-spraying coat 3, and the property only based on the ceramic-flame-spraying coat 3 can be improved or reformed. For example, insulation higher than the insulation only by the ceramic-flame-spraying coat 3 can be given to the compound coat 4, and properties, such as thermal resistance and high temperature corrosion-proof, can be

further improved to it.
[0025] Moreover, according to the formation approach of the compound coat of the surface of metal of this invention, the undercoat 2 which most becomes from titanium nitride can be formed easily and certainly.

TECHNICAL PROBLEM

[Description of the Prior Art] In forming a ceramic-flame-spraying coat in a surface of metal, in order to ease the difference of the coefficient of thermal expansion of a metal and a ceramic and to raise both adhesion, generally forming among both the undercoat which consists of an ingredient which has both middle coefficient of thermal expansion is performed. And undercoat was what consists of a metal conventionally.
[0003] By the way, the purpose which forms a ceramic-flame-spraying coat in a surface of metal has insulating improvement, heat-resistant improvement, etc. variously. For example, in aiming at insulating improvement, it forms the thickness which presents desired insulation, and the ceramic-flame-spraying coat of an ingredient. However, since there was an upper limit in the thickness of the ceramic-flame-spraying coat which can be formed, there was a limitation also in insulating improvement. Such a limitation was the same also in the manifestation of other properties not only based on insulation but a ceramic-flame-spraying coat.
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MEANS

[Means for Achieving the Goal] The compound coat of the surface of metal of this invention is characterized by a substrate sprayed coating using titanium nitride as a principal component in the compound coat which consists of undercoat formed in the surface of metal, and a ceramic-flame-spraying coat formed on undercoat.
[0006] The formation approach of the compound coat of the surface of metal of this invention is characterized by carrying out thermal spraying of the titanium in atmospheric air, and forming undercoat in the approach of forming a ceramic-flame-spraying coat in a surface of metal through undercoat, and forming the compound coat which consists of both sprayed coatings.

OPERATION

[Function] In the compound coat of the surface of metal of this invention, since most substrate sprayed coatings consist of titanium nitride, undercoat will discover the property as a ceramic. Therefore, the property of a compound coat becomes that to

which the property as a ceramic of undercoat acted on the property as a ceramic of a ceramic-flame-spraying coat.
[0008] Since titanium reacts in atmospheric air and tends to turn into titanium nitride, according to the formation approach of the compound coat of the surface of metal of this invention, most substrate sprayed coatings consist of titanium nitride.

EXAMPLE

[Example] Drawing 1 is the sectional view showing the compound coat formed by the approach of this invention. As for the substrate with which 1 consists of an aluminum member, and 2, in drawing, undercoat and 3 are ceramic-flame-spraying coats. The compound coat 4 consists of both sprayed coatings 2 and 3. The White alumina was used as a ceramic of the ceramic-flame-spraying coat 3, using A5052 as an aluminum member of a substrate 1. Moreover, in the thickness of a substrate 1, the thickness of 6mm and undercoat 2 set thickness of 50-100 micrometers and the ceramic-flame-spraying coat 3 to 200-300 micrometers.
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[Table 1]

	下地溶射皮膜の場合	セラミック溶射皮膜の場合
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プラズマガス(Ar)量	60 ℓ/min	
ミックスガス(N_2)量	0	
パウダーガス(Ar)量	5 ℓ/min	
パウダー供給量	0．8kg・f/h	3．0 kg・f/h
溶射距離(mm)	120mm	70mm

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・結果

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[0023] Moreover, as a metal of a substrate 1, various ferrous materials, copper, a copper alloy, titanium, a titanium alloy, a nickel radical alloy, a cobalt base alloy, etc. may be used, and a zirconia, a titania, a spinel, yttria, etc. may be used as a ceramic of the ceramic-flame-spraying coat 3, for example.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view showing the compound coat formed by the approach of this invention.
[Drawing 2] It is the photograph which replaces the drawing in which the structure of a crystal is shown, and a part of drawing 1 is expanded and shown.
[Drawing 3] It is the X diffraction Fig. showing the presentation of undercoat.
[Description of Notations]
1 Substrate
2 Undercoat
3 Ceramic-Flame-Spraying Coat
4 Compound Coat